

# Reliability assessment of European commercial MMIC components for space

ESA Contract No. 4000136133/21/NL/FE

Aintzane Lujambio | 26.03.2025



# Reliability assessment of COTS MMICs for space

## Presentation overview

1. Context and background
2. Market survey and device selection
3. Test plan definition
4. Test setup development
5. Project status
6. Conclusions



# Reliability assessment of COTS MMICs for space

## Context and background

The trend in **using COTS** within the space industry is growing, justified due to several factors such as **performances, cost or availability**.

This tendency covers all types of component families including **complex devices** such as MMICs.

Traditional space components were based on ceramic hermetic devices, but we can now have access to **COTS MMICs** with high potential for their use in space, either as bare die or encapsulated in plastic packages.

However, their **suitability for space applications** needs to be investigated.

# Reliability assessment of COTS MMICs for space

## Context and background

### Funding:

- ESA contract No. 4000136133/21/NL/FE



### Ambition:

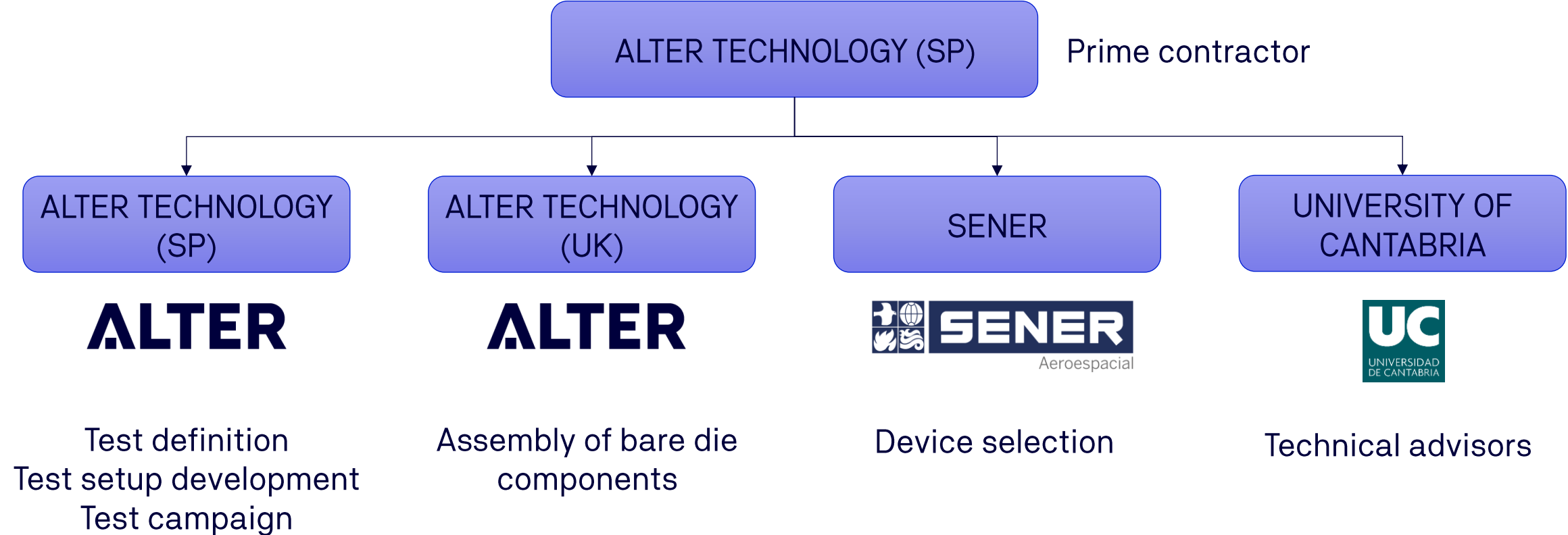
- To **assess the reliability** of commercial MMIC components for their use in space.

### Objectives:

- Identify **COTS MMICs offering** in European industry.
- **Selection** of four MMIC devices, and **assessment** of their use for space application.
- Use the process to **identify critical issues** possibly affecting the reliability of such parts for space use.

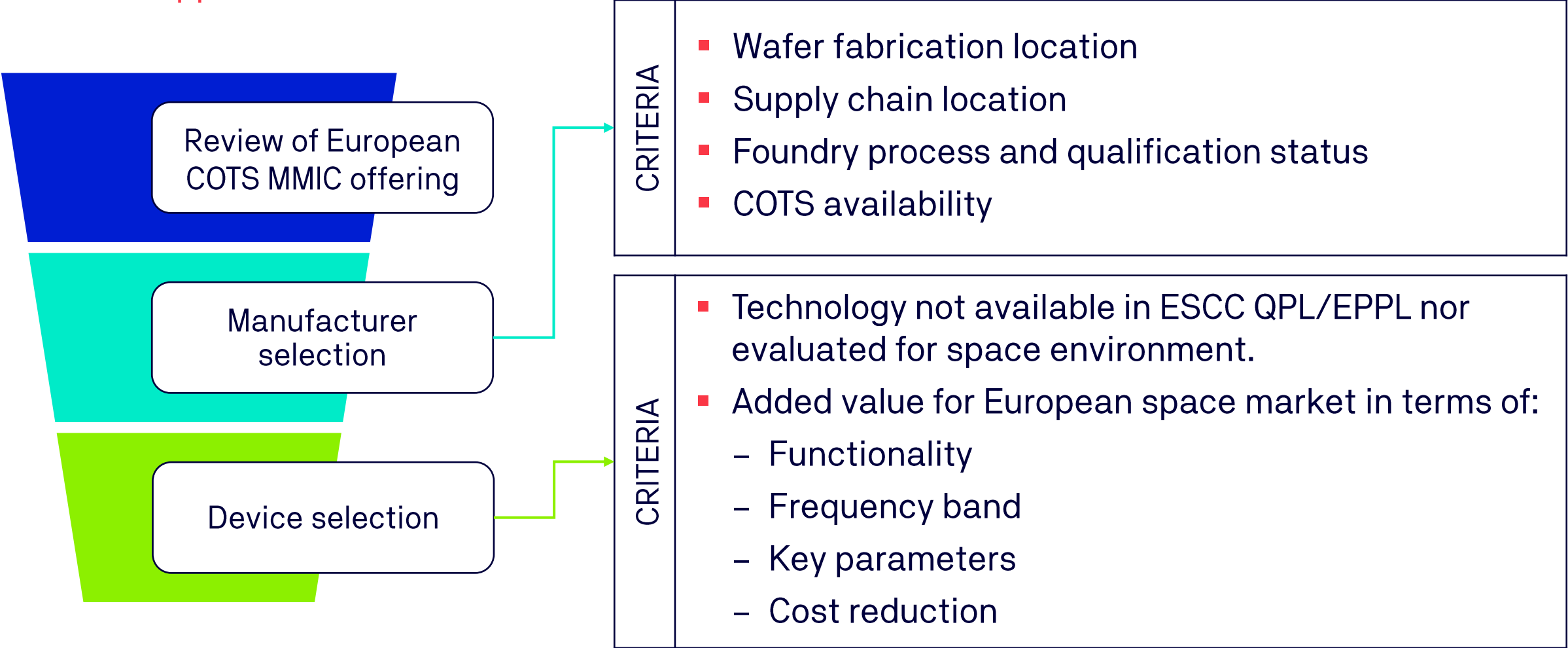
# Reliability assessment of COTS MMICs for space

Project consortium



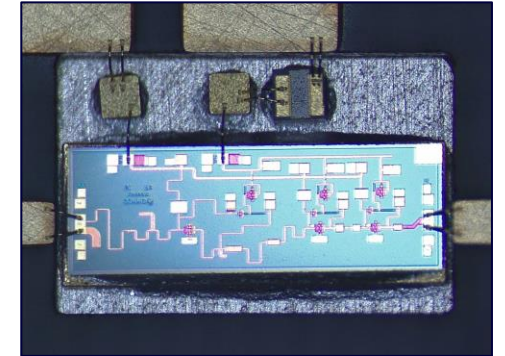
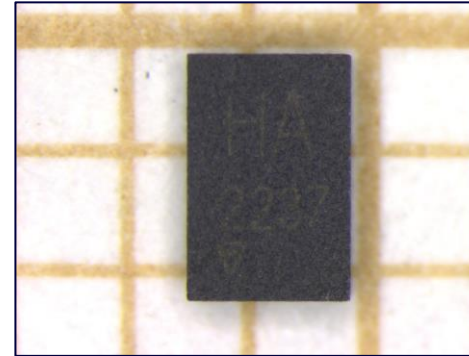
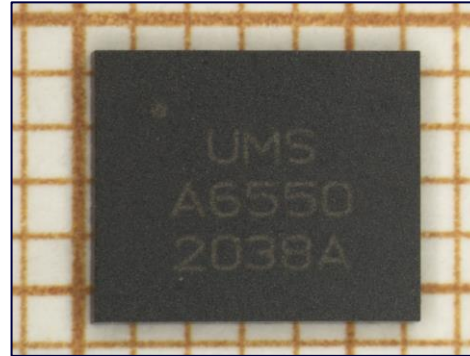
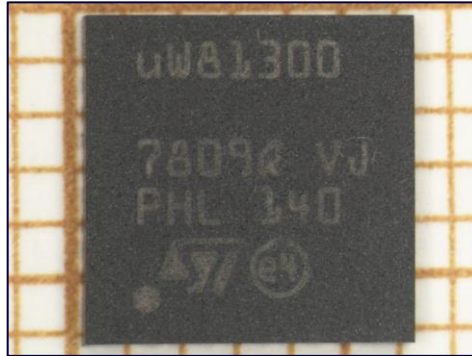
# Market survey and device selection

## Selection approach



# Market survey and device selection

## Final device selection



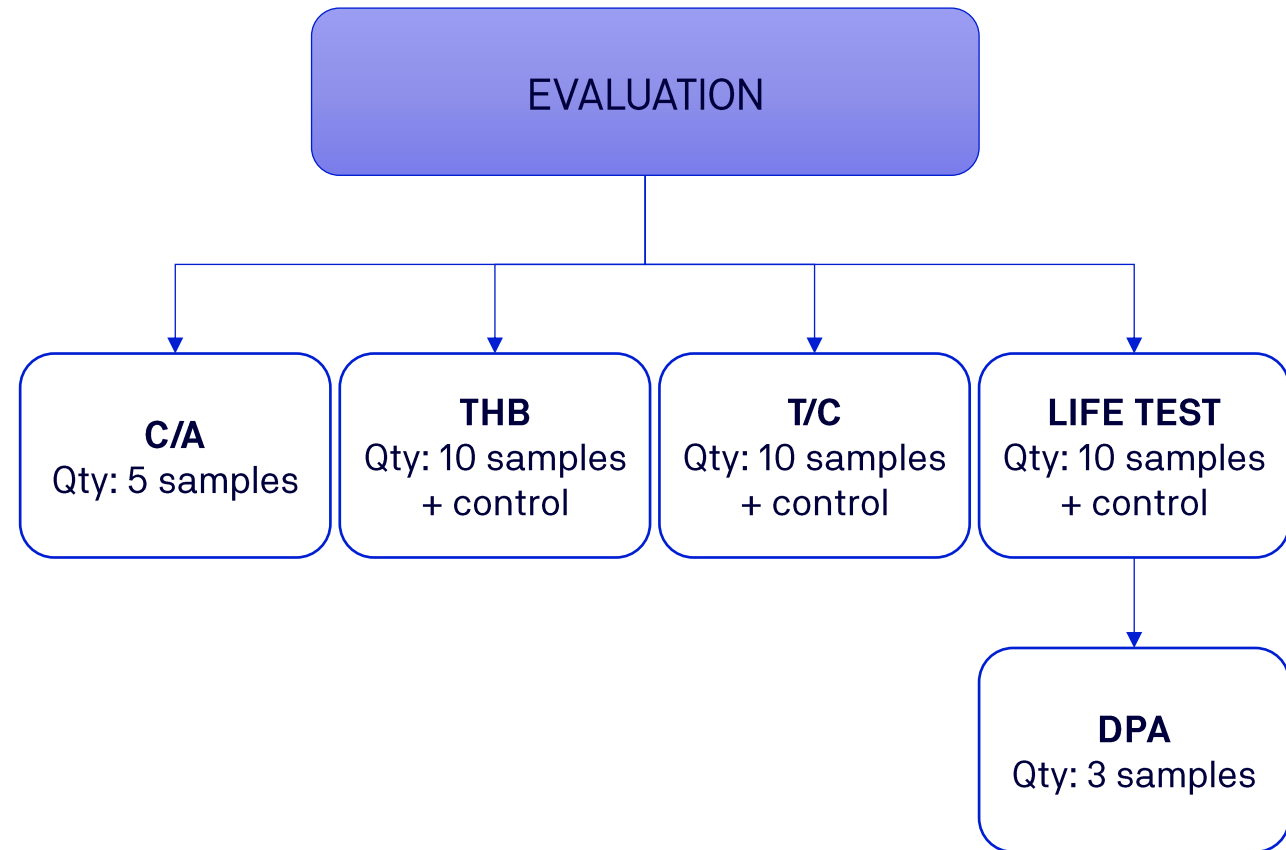
Device	STuW81300	CHA6550-QXG	LPH070R-01	CGY2250UH/C1
Manufacturer	ST Microelectronics	UMS	Infineon	MACOM (formerly OMMIC)
Function	Wideband RF/Microwave synthesizer	High Power Amplifier	IF Amplifier	Low Noise Amplifier
Technology	SiGe BiCMOS	GaAs	SiGe BiCMOS	GaN
Frequency	1.925 – 16 GHz	17.0 – 23.6 GHz	Up to 10 GHz	26 – 34 GHz
Package	VFQFPN36	QFN36	TSLP-7-1	Bare die

# Test plan definition

Based on ECSS-Q-ST-60-13C

**Class 2 evaluation** test flow as baseline, tailored as follows:

- Radiation was not included, and electrical characterization subgroup was also skipped.
- Mechanical test (applicable only to bare die) and temperature cycling will not be performed on bare die device.
- Humidity test will be applied for both plastic package (for 1000h) and bare die (for 168h).
- Life test will be divided into DC and RF life test for the high-power amplifier.



# Test plan definition

Based on ECSS-Q-ST-60-13C

An **evaluation test plan** has been edited for each device:

- Part identification
- Absolut maximum ratings
- Quantities and sample breakdown
- Detailed test flow definition including test method
- Electrical test parameters and conditions
- Environmental test conditions (bias, temperature, humidity)

**ALTER TECHNOLOGY**  
EVALUATION TEST PLAN

ESA CONTRACT NO. 4000136133/21/NL/FE  
"RELIABILITY ASSESSMENT OF EUROPEAN COMMERCIAL MMIC COMPONENTS FOR SPACE"

PART TYPE: LPH070R-01

BASED ON  
SiGe:C NPN RF bipolar technology LNA

MANUFACTURER: INFINEON

Alter reference:	ATN-SC-1028	Issue:	Issue 3	Signature:	Date:
Prepared by:	ATN project team		N. A.		2024/04/08
	UNICAN project team		N. A.		2024/04/08
Reviewed by:	ATN UK and SENER project team		N. A.		2024/04/08
Approved by:	Jouni Laiti				

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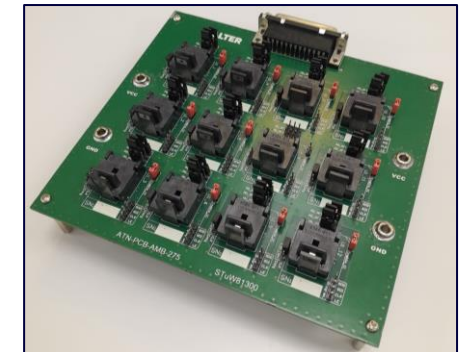
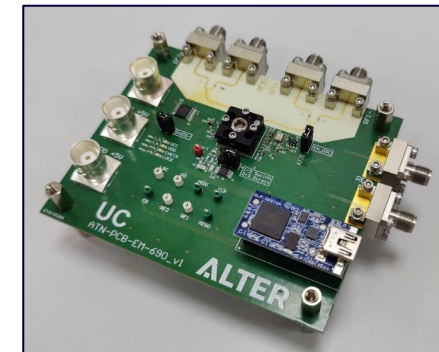
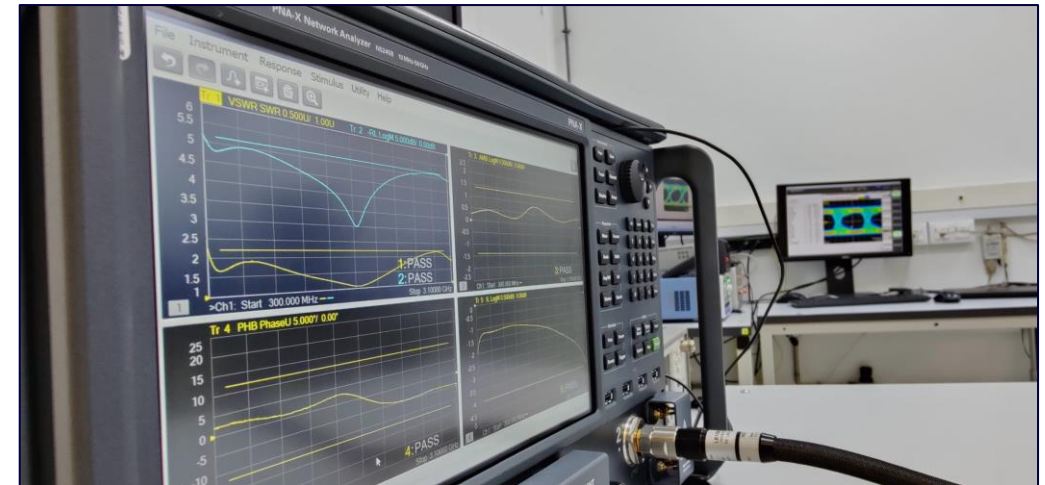
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# Test setup development

## Preparation activities

Based on the test plan definition

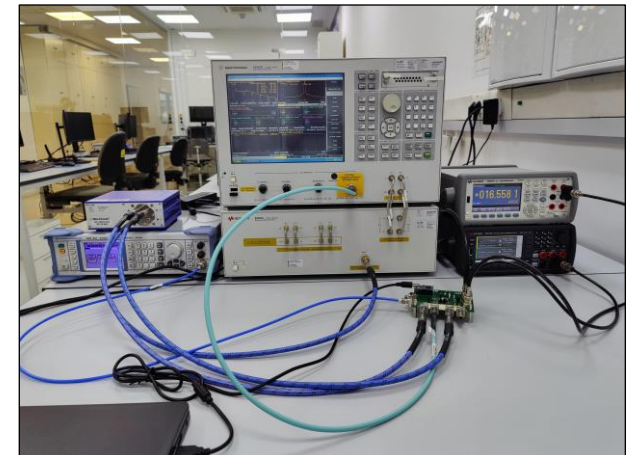
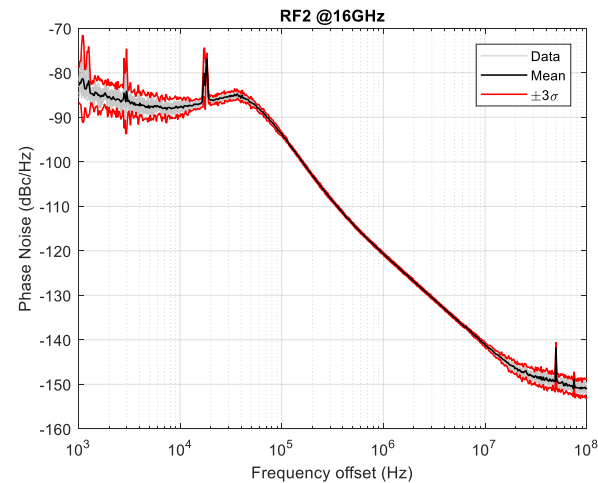
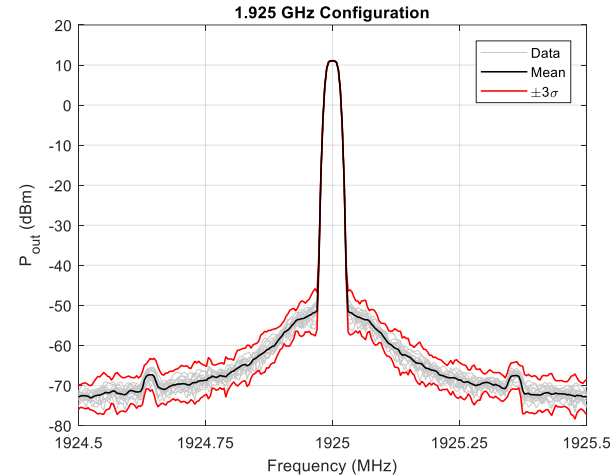
- Electrical characterization:
  - Equipment selection
  - Test fixture design and manufacturing
  - Test automation
  - Test setup validation
- Biased environmental tests:
  - Environmental test board design
  - Pilot tests



# Test setup development

## STuW81300 - Wideband RF/Microwave synthesizer

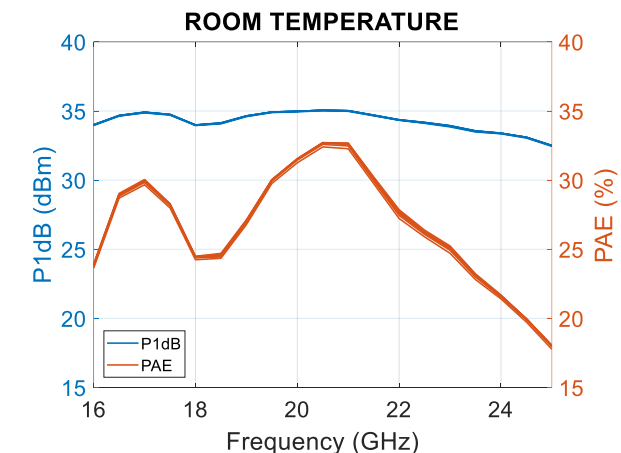
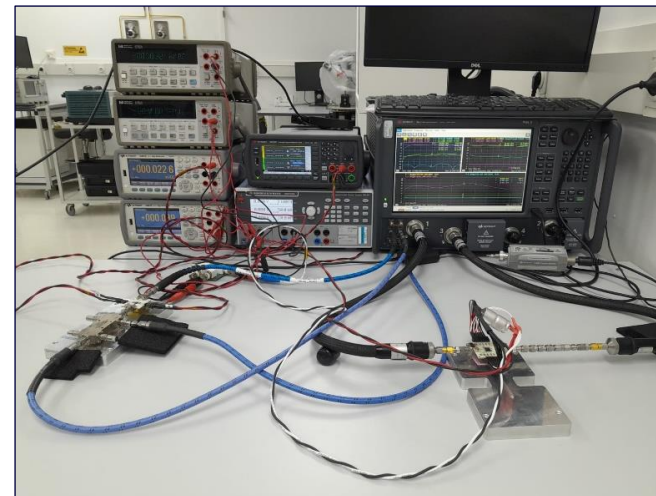
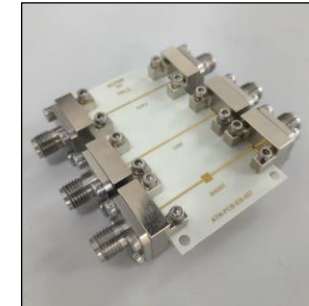
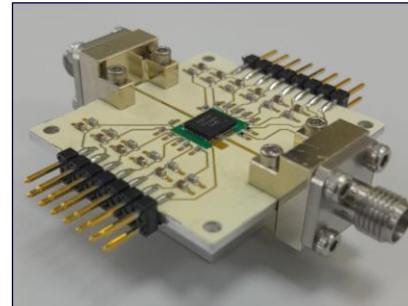
- Test board with socket
- Test parameters to cover main functionality on all the operation frequency range (1.625 – 16 GHz)
  - Output frequency
  - Output power
  - Phase noise
  - ICC, IPD
  - LDO outputs
  - SPI functionality



# Test setup development

## CHA6550-QXG – Power amplifier

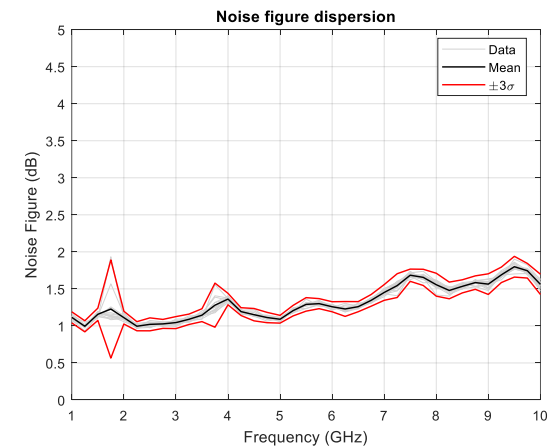
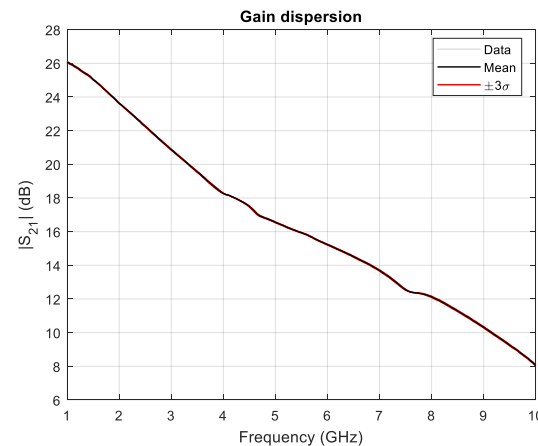
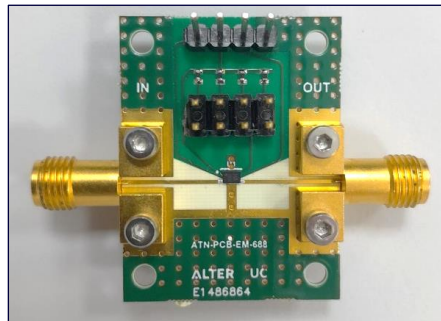
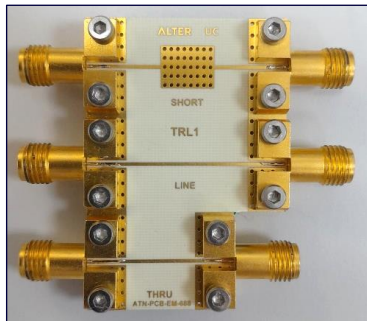
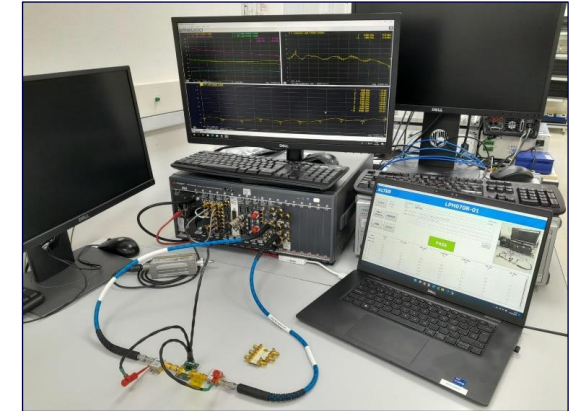
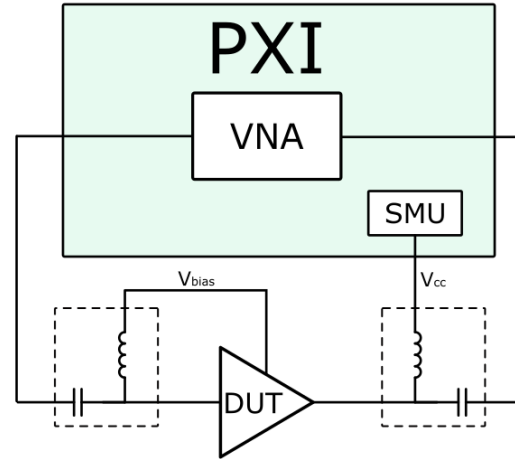
- Samples soldered into test jigs (heat dissipation). Position of decoupling capacitor has been critical to avoid oscillations.
- Custom TRL calibration kit.
- Bias adjustment, protection, and monitoring board for environmental tests.
- Small and large signal measurements are performed using the same test bed with different adjustments on attenuators.
- RF (4 pcs) and DC (6 pcs) life tests



# Test setup development

## LPH070R-01 – IF amplifier

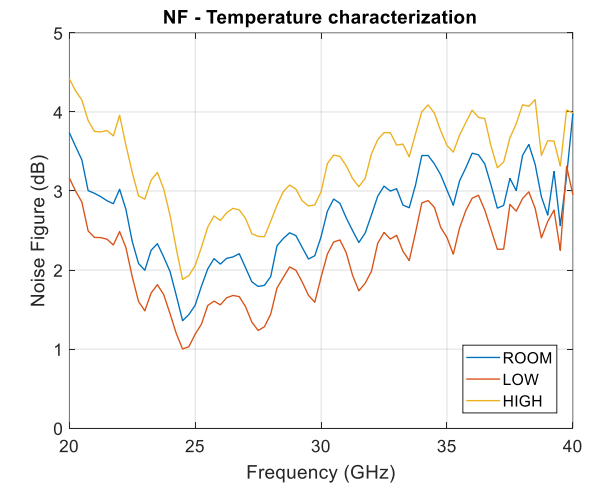
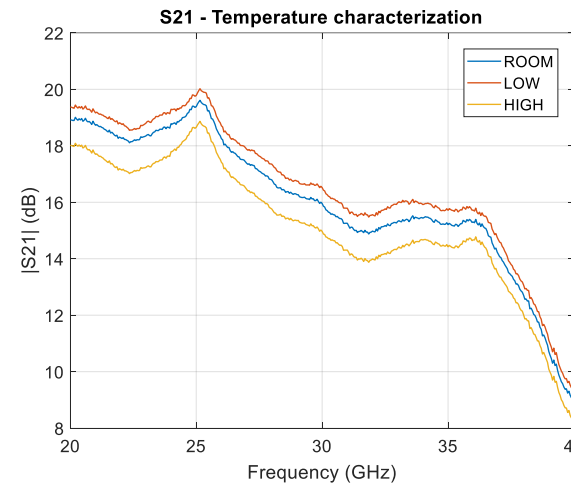
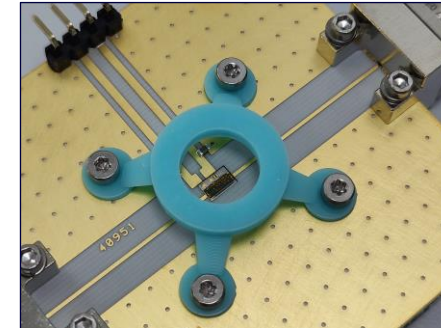
- Samples soldered into test jigs.
- Test bed for small-signal, noise figure and P1dB measurements based on a PXI VNA module.
- Custom TRL calibration kit.
- Environmental boards including external bias-tees.



# Test setup development

## CGY2250UH/C1 – Low noise amplifier

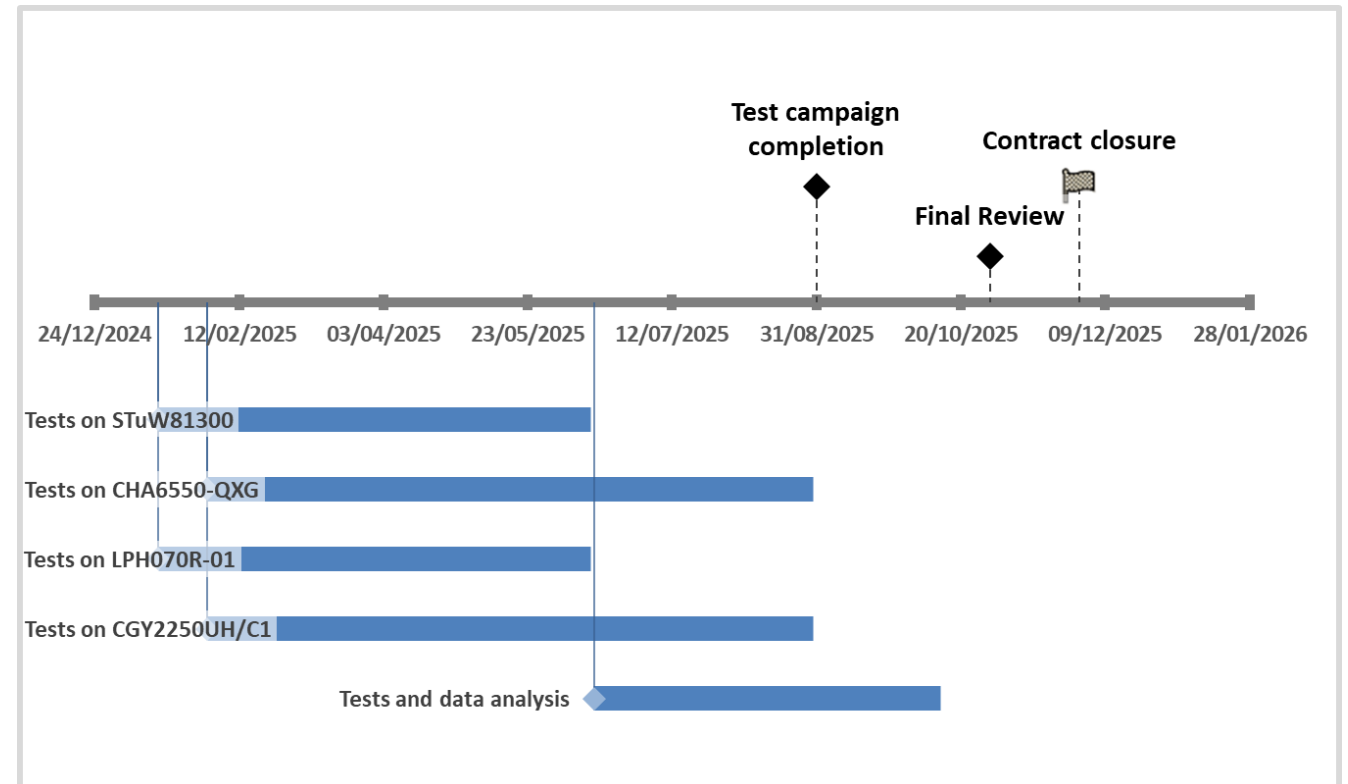
- Bare die assembled on test jigs.
- 3D printed cover to protect the die during handling, but keeping the die exposed for humidity testing.
- Test bed for small-signal and noise figure measurements based on a PXI VNA module from 20 to 40 GHz.



# Project planning

## Current status

- TRR has been completed.
- Test campaigns are now running and planned to be completed in few months.
- Once completed, test results and data will be analysed before final review and contract closure



# Reliability assessment of COTS MMICs for space

## Conclusions

- The trend in **using COTS** within the space industry is growing, justified due to several factors such as **performances, cost or availability**, including complex devices such as MMICs.
- Their **suitability for space applications** needs to be investigated, which is the objective of the project presented in this talk.
- **Four European COTS MMICs of different technologies** have been selected for their evaluation following ECSS-Q-ST-60-13C class 2 evaluation requirements.
- **Test campaigns are currently on-going**, and completion of the project is expected within this year.

**Thank you for your attention!**



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